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USAF THEATER AIR CONTROL SYSTEM: WHERE DO WE GO FROM HERE?

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Abstract
What will the Theater Air Control System (TACS) need to do to remain a viable and capable part of the Air Forces Command and Control (C2) system of the future? The USAF is in the midst of some significant changes as it approaches the start of the new century. Among these changes is the new Expeditionary Aerospace Force (EAF) concept. This concept, which is quickly becoming reality and Air Force doctrine, requires a leaner, more expeditionary force with a leaner and yet significantly enhanced C2 capability. Major strides are being made to modernize C2. The TACS is going to need to undergo the same type of modernization if it is going to continue to be a viable link to the theater commanders C2 capability. By modernizing TACS and C2 with respect to the requirements posed by the EAF, the Air Force can produce an Aerospace Power capable of full integration into the Joint Warfighting environment of the future.

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ABSTRACT *(MAXIMUM 200 WORDS)*

WHAT WILL THE THEATER AIR CONTROL SYSTEM (TACS) NEED TO DO TO REMAIN A VIABLE AND CAPABLE PART OF THE AIR FORCE'S COMMAND AND CONTROL (C2) SYSTEM OF THE FUTURE? THE USAF IS IN THE MIDST OF SOME SIGNIFICANT CHANGES AS IT APPROACHES THE START OF THE NEW CENTURY. AMONG THESE CHANGES IS THE NEW EXPEDITIONARY AEROSPACE FORCE (EAF) CONCEPT. THIS CONCEPT REQUIRES A LEANER, MORE EXPEDITIONARY FORCE WITH A LEANER AND YET SIGNIFICANTLY ENHANCED C2 CAPABILITY. MAJOR STRIDES ARE BEING TAKEN TO MODERNIZE C2. THE TACS IS GOING TO NEED TO UNDERGO THE SAME TYPE OF MODERNIZATION IF IT IS GOING TO CONTINUE TO BE A VIABLE LINK TO THE THEATER COMMANDER'S C2 CAPABILITY. AS OF YET THE AIR FORCE HAS NOT FULLY INTEGRATED THE MODERNIZATION EFFORTS OF THE EAF, C2, AND THE TACS. THE AIR FORCE MUST ALIGN ITS MODERNIZATION EFFORTS.

THE SINGLE MOST IMPORTANT ENABLER FOR THE EAF IS A ROBUST C2 CAPABILITY. THIS C2 CAPABILITY IS UNABLE TO EXIST WITHOUT THE MODERNIZATION OF THE TACS, WHICH IS A CRITICAL LINK INTO THAT C2 SYSTEM. BY MODERNIZING TACS AND C2 WITH RESPECT TO THE REQUIREMENTS POSED BY THE EAF, THE AIR FORCE CAN PRODUCE AN AEROSPACE POWER CAPABLE OF FULL INTEGRATION INTO THE JOINT WARFIGHTING ENVIRONMENT OF THE FUTURE.

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OUTLINE

Executive Summary

Title: USAF Theater Air Control System: Where Do We Go From Here?

Author: Major James K. Smith, United States Air Force

Thesis: What will the Theater Air Control System (TACS) need to do to remain a viable and capable part of the Air Force's Command and Control (C2) system of the future? The USAF is in the midst of some significant changes as it approaches the start of the new century. Among these changes is the new Expeditionary Aerospace Force (EAF) concept. This concept, which is quickly becoming reality and Air Force doctrine, requires a leaner, more expeditionary force with a leaner and yet significantly enhanced C2 capability. Major strides are being made to modernize C2. The TACS is going to need to undergo the same type of modernization if it is going to continue to be a viable link to the theater commander's C2 capability.

Discussion: As the Air Force enters the new century, it has organized itself into an expeditionary force capable of responding to any crisis worldwide. The only solution for guaranteeing the success of this new fighting force is robust and responsive C2. Being the key enabler for expeditionary operations, C2 ensures connectivity at every level of warfighting. Proceeding down two paths of modernization, reorganization into an EAF and building a robust C2 capability, it is imperative that the Air Force does so in congruent fashion. If the TACS is going to remain a viable part of that C2 capability it must continue along the same modernization trail.

As of yet, the Air Force has not fully integrated the modernization efforts of the EAF, C2 and the TACS. The Air Force must align its modernization efforts to those described in this paper. Only then can robust expeditionary C2 enhanced by the TACS be expeditiously and efficiently acquired for expeditionary operations.

Conclusion: The single most important enabler for the EAF is a robust C2 capability. This C2 capability is unable to exist without the modernization of the TACS, which is a critical link into that C2 system. Without the capability to adequately communicate with and control its expeditionary forces, the EAF will be unable to respond to the needs of the warfighting CINCs. By modernizing TACS and C2 with respect to the requirements posed by the EAF, the Air Force can produce an aerospace power capable of full integration into the joint warfighting environment of the future.

Introduction

We are at the dawn of a new century. Unfortunately, no one really knows what this century has in store. The U.S. is fortunate to be the one sole superpower in existence today. That said, for how long this will remain is anyone's guess. What we do know is that change is inevitable. We also know that change is taking place at an ever-increasing rate. What does that mean to the U.S., or more specifically to the U.S. military? It means that if we want to remain the world's superpower, then we must continue to lead the rest of the world, not only in politics and economics but also in military capability. We can ill afford to rest on our past military success and assume that tomorrow's threat will be unable to match our military might. If we fail to improve as a military, it clearly won't be long before we wake up to find ourselves being defeated on the battlefield. This, of course, is a statement of the obvious, but I choose to mention it here only to remind us that we must continue to strive to find new and better ways of accomplishing our mission.

The purpose of this paper is to focus on improving the Air Force's Theater Air Control System (TACS). The TACS is the system that feeds a great deal of information to the Air Operation Center (AOC). In fact, the AOC is the senior element of the TACS. This system provides the Joint Force Air Component Commander (JFACC) the organization, personnel, procedures, and equipment necessary to provide battlespace management in support of theater air operations and coordinated air operations with other joint and/or combined forces.

Air Force leadership is currently focused on two major issues which greatly impact the TACS. Each of these are driving the requirement for an improved TACS. The first issue is the Expeditionary Aerospace Force (EAF). The EAF being basically a new way of organizing and deploying air forces. These forces are focused on being lean and expeditionary. The second issue is Command and Control (C2) modernization. The Air Force is taking the lead in this effort, trying to leverage

technology in order to present a clearer picture of the battlespace and reduce the fog and friction of war. Much of this C2 modernization will also translate into better, more efficient ways to prosecute the war. Although the Air Force is taking the lead in the C2 modernization effort, each of the other services are joining in the fight. Each of the services has a vested interest in creating this global C2 network which will provide the warfighting CINCs with the ability to out-think and out-maneuver their adversaries. Just as our commanders were able to out-think and out-maneuver the Iraqi army during Desert Storm.

Although the Air Force is taking some positive steps in the way it is organizing using the EAF, as well as some positive steps on how it plans to command and control its forces in the future, it doesn't appear to be approaching these changes in an integrated fashion. The TACS is a key part of the Air Force's C2 system and yet it doesn't seem to be a focus of the C2 modernization effort, (with the exception of the AOC modernization effort which seems to be the primary focus). The other elements of the TACS seem to have been neglected. This is the problem this paper will address and ultimately provide recommendations/conclusions towards.

My approach will be to first, look at the TACS and how it is organized as well as its mission. I will then discuss the role it played during Desert Storm and look at some of the lessons learned which relate to the TACS. From there, I will shift gears and look at where the Air Force is heading with its focus on the EAF and C2 modernization. Within the C2 modernization issue is a number of other issues the Air Force is addressing and I will touch on a few of the TACS related ones. Ultimately, I will attempt to tie both the EAF and C2 modernization issues back to the need to modernize the TACS in an integrated manner.

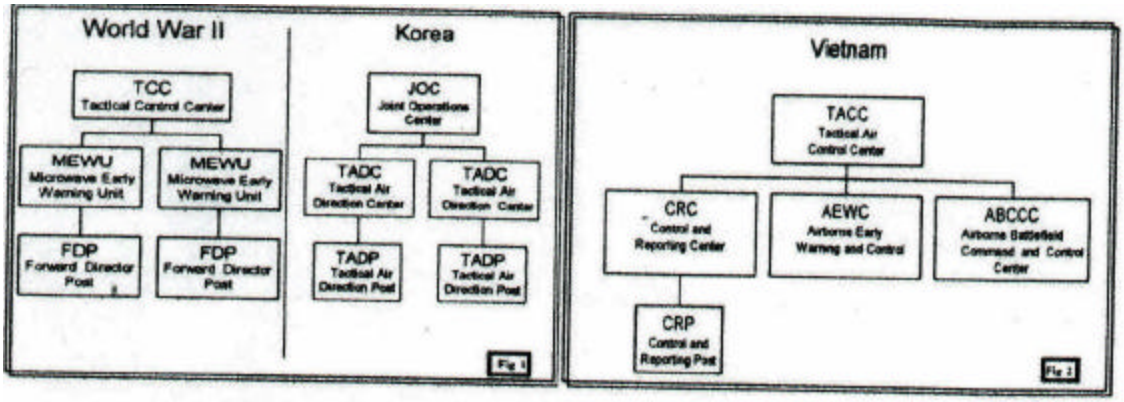
The TACS Today

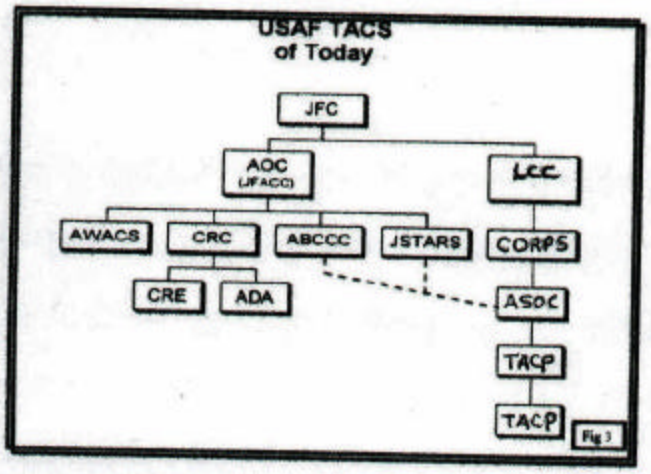
The structure of the TACS we operate under today has its roots in the early C2 architecture of World War II. The USAF's TACS patterned itself after the Royal Air Force's air defense system used by Fighter Command in the Battle of Britain in 1940. The RAF was the first to integrate its Fighter Groups with the Radar Group, Observer Corps and Anti-Aircraft Command enabling early warning and surveillance within the RAF's Fighter Command to rob the element of surprise from Germany's Luftwaffe. [1] Although technology has resulted in some advances in radar and communications capabilities, the components, functions, and command structure has changed little. In fact, except for some name changes and the advent of airborne C2 platforms like AWACS, ABCCC, and JSTARS, the TACS has remained virtually the same throughout WWII, Korea, Vietnam, Desert Storm and Allied Force.[2]

Organization Past and Present

As with the structure of today's TACS, the structures of the past were vertical in nature, both for command and for information flow. Planning and close supervision of the employment of airpower has always been done at the very highest levels. Although Vietnam saw the fielding of an entirely new type of command and control platform, the introduction of airborne elements of the TACS did not change the underlying fundamental principle of centralized command and control with decentralized execution. Figures below show the evolution of the TACS since its early WWII days until the present. The command, control, and execution concepts for the TACS today is virtually the same as it has been for nearly 60 years. (See Figures 1,2, and 3).

[1] Norman Franks, *Battle of Britain*, (New York: Bison Books Limited), 1981, p 11-12.





Figures 1-3.

The true test of the Air Force's ability to meet the demands of future battle will be determined by its approach to the tasks of planning, commanding, controlling, and executing air power. This is the purpose of the TACS. The TACS provides the Air Force Component Commander (AFCC) and the Joint Force Air Component Commander (JFACC) the capability to plan and conduct theater air operations, including joint U.S. operations and combined operations with allied forces. The TACS supports the Air Force doctrine of centralized control and decentralized execution of theater air

[2] Miller, Michael E., Major, USAF, *USAF Theater Air Control System Battle Management: Preparing For Future, High-Tempo Operations*, MCSC Thesis, Quantico, VA, 1996-97, p 7.

support assets.[3] The senior TACS element, the Air Operations Center (AOC), takes JFACC guidance as approved by the Joint Forces Commander (JFC) (i.e. apportionment decisions) and develops the air operations plan, allocates resources, and tasks forces through the Air Tasking Order (ATO). The AFCC if appointed the JFACC by the JFC, normally serves as the Area Air Defense Commander (AADC) and Airspace Control Authority (ACA). The TACS is a transportable C2 system which can be tailored for large or small scale operations in varying intensities of warfare. The TACS elements can be deployed as a complete system or incrementally to augment an existing theater fixed/mobile system.[4] In the case of Desert Storm, there was an existing air control system which required a great deal of augmentation.

C2 and the TACS in Desert Storm

Each theater or contingency where air forces are employed, whether in conjunction with ground forces or by themselves, requires some form of control of planning and operations. The major components of the TACS provide the air component commander with the tools necessary to adapt his specific command and control system to his unique requirements. In the case of Desert Shield/Desert Storm, Lt. Gen. Charles A. Horner, the first official JFACC in time of a contingency, exercised his authority through his TACS as depicted in Figure 4.

Tactical Air Command Manual 2-1, Tactical Air Operations, defines the TACS as a "system for planning, directing, coordinating and controlling theater air operations".[5] In operation Desert

[3] AFDP 13-1, "Theater Air Control System", HQ USAF/XOFI, , 11 May 1985, p 1.
[4] For more information on the USAF's TACS refer to AFDP 13-1, *Theater Air Control System,* and Joint Pub 3-56.1, *Command and Control for Joint Air Operations.*
[5] TAC Manual 2-1, "Tactical Air Operations," HQ Tactical Air Command, Langley AFB, VA, Aug 1991, p 5-9.

Shield, that system was put together piecemeal. Yet it was operating as a whole system in a month and was multinational by the end of December 1990.[6] Giving it that capability, however, depleted the command and control units in the U.S. and Europe and left the U.S. with no effective USAF tactical air command and control reserve.[7] Overall, however, the story of the development of the TACS in the theater is noteworthy because of both its complexity and its success. The latter enabled Lt. Gen. Horner, the JFACC, to bring the full weight of coalition air power to bear on the forces of Iraq.

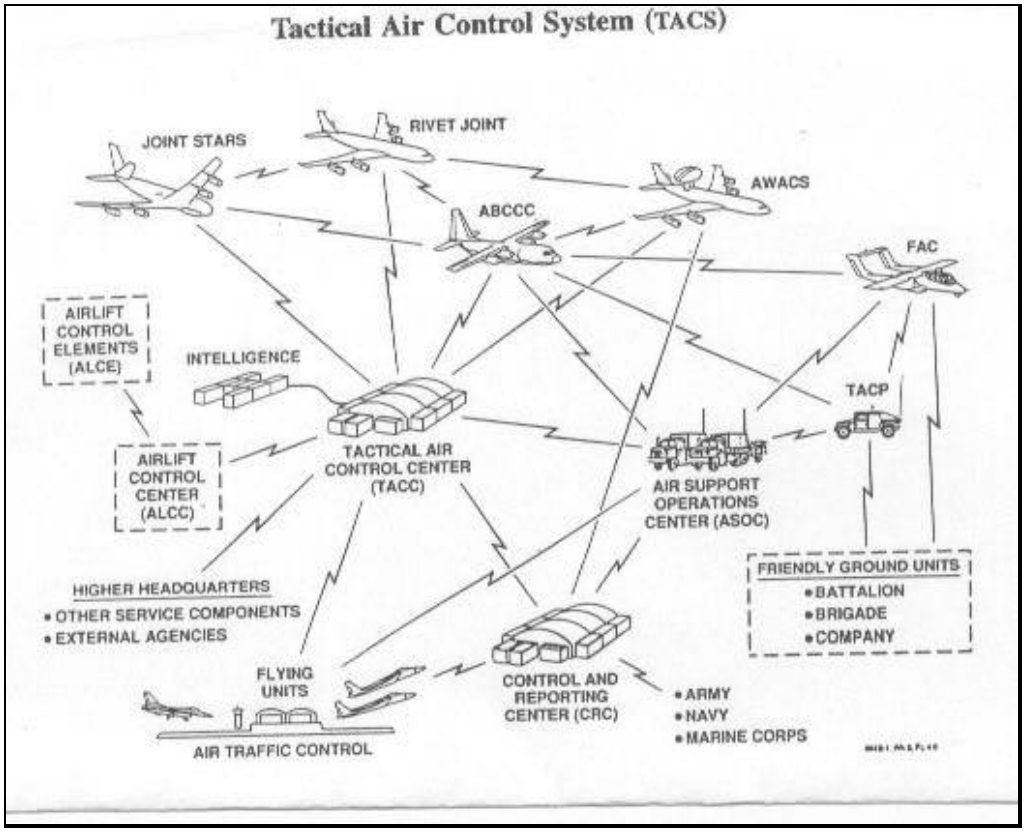


Figure 4.

The growth of the TACS was delayed by the CINC's (General H. Norman Schwarzkopf)

[6] Gulf War Air Power Survey, Vol. 1, Planning and Command and Control, 1993, p. 129.
[7] Ibid. p 130.

decision to put a higher priority on the movement of combat units into theater. A wise decision that undoubtedly related to the lack of airlift available and the enormous lift requirements of certain TACS units (ie...it takes 24 C-141s and 5 C-5s to lift a CRC). Setting up an effective TACS did not come cheap. At the beginning of Desert Storm all of the Air Force's ABCCC aircraft were under CENTAF's command. CENTAF had 6 of the 8 available EC-130 Compass Call electronic warfare aircraft, 3 of 5 deployed Air Support Operation Centers (ASOCs), 2 of the 5 deployed Control and Reporting Centers (CRCs), both of the developmental E-8A JSTARS aircraft, and 124 of the 184 deployed Tactical Air Control Parties (TACPs). The European Command sent 25 percent of its intelligence manpower to CINCENT and most of its tactical communications to Saudi Arabia or to Proven Force in Turkey. Also, the Strategic Air Command committed all available RC-135V Rivet Joint aircraft, which are national assets, under Joint Chief's control, to the theater.[8]

A major task of the TACS is to control friendly aircraft in flight. This is a multifaceted task with a number of objectives. The TACS allows the JFACC the flexibility to retask aircraft enroute (time sensitive targeting) to ensure effective and efficient application of airpower within a very dynamic combat environment. The TACS provides airborne control of strike aircraft and tanker aircraft for pre-strike and post-strike aerial refueling. The TACS controls friendly airspace to deconflict air traffic, much like the civilian air traffic control system does. The TACS also identifies and tracks enemy aircraft to direct interceptions by friendly tactical fighter aircraft.

The TACS, when it works effectively, allows an air commander and his forces to keep enemy aircraft away from high-value friendly targets while permitting the flow of friendly combat and transport aircraft. During Desert Shield and Desert Storm, the normally complex problem of monitoring, controlling, and defending a large airspace was compounded by the need to support the

[8] Robert S. Hopkins, III, "Ears of the Storm," Air Force Magazine, Vol. 75, No. 2 (Feb 1992), p 42.

Saudi civil air traffic control process without supplanting it. In addition, Lt. Gen. Horner, as the Airspace Control Authority, was responsible for ensuring that aircraft from a multi-national coalition flew freely above their own ground forces and those of their allies. This was no simple task given all coalition aircraft didn't have the same identification systems carried on the U.S. aircraft.

The TACS was also required to perform the theater air defense mission. Theater air defense is really more than just defense; it is also a matter of not shooting down friendly aircraft. In this case, U.S. forces had to be integrated into "the existing Saudi/Gulf Cooperation Council (GCC) air defense system…" Under this system, allied airspace was "divided into seven air defense/airspace control sectors to allocate air defense and airspace management resources."[9] Figure 5 illustrates the

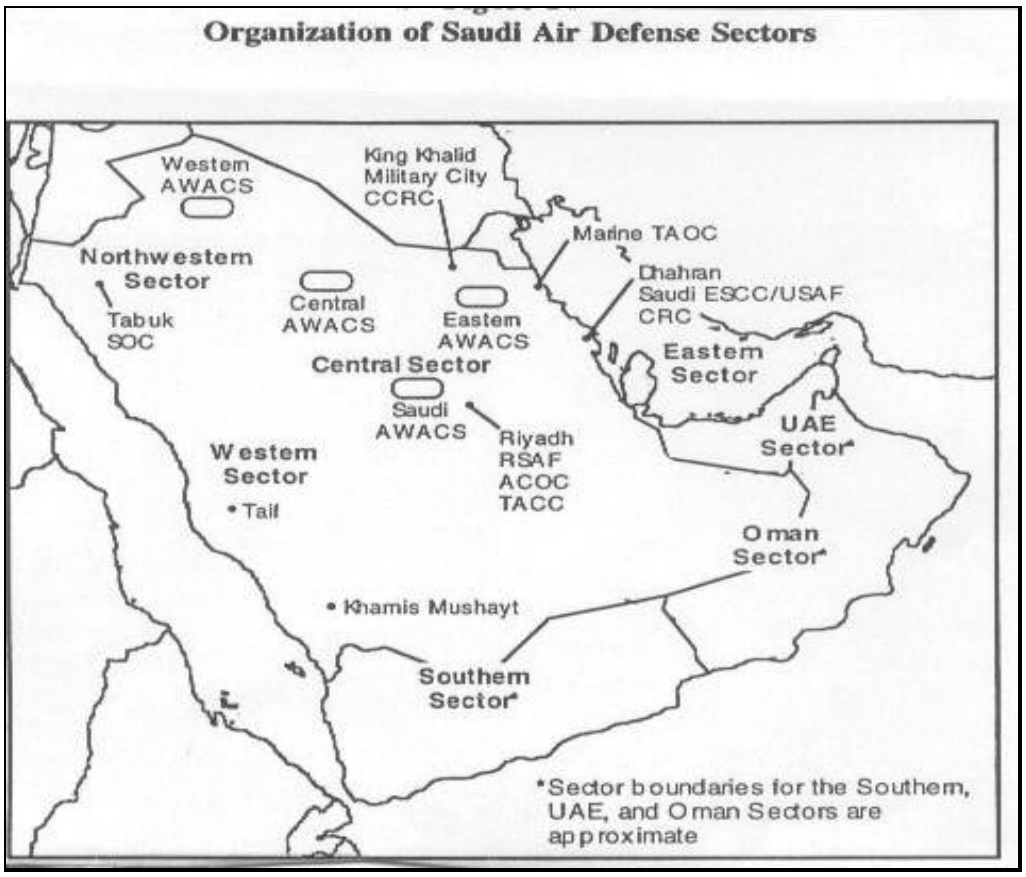


Figure 5.

[9] Rpt, "AWACS Orbits," Maj John Adams/CSS Tac Clt, 14 Aug 1990.

organization of Saudi air defense sectors.

Airspace management is the complement to air defense. The latter aims to keep out intruders, the former aims to keep friendlies from interfering with one another, especially over friendly territory. In short airspace managers are the traffic cops of the sky, regulating the movement of aircraft along air corridors, within air refueling tracks, and around friendly airfields.

The following discussion should give you an idea of just how difficult a job these controllers/battle managers had. During Desert Shield and Desert Storm, the Central Command Air Forces combat airspace management branch within the AOC used a computer tool, the Combat Airspace Deconfliction System (CADS), to build the Airspace Control Order (ACO). Combat airspace managers separated multi-service, multi-national air forces flying 3,000 sorties per day in a complex airspace structure. The numbers of areas, zones, routes, and orbits which had to be monitored and controlled are impressive: 160 restricted operating zones,122 airborne refueling orbits, 32 combat air patrol areas, 10 air transit routes, 36 training areas, 76 strike routes, 60 Patriot engagement zones, 312 missile engagement zones, 11 high density aircraft control zones, 195 army aviation flight routes, 14 air corridors, 46 minimum risk routes, 60 restricted fires areas, 17 airbase defense zones, and numerous Aegis engagement zones.[10]

Considering the complexity of the TACS/C2 system and the number of friendly aircraft flying in such a small airspace during Desert Storm, it functioned amazingly well. There was not a single aircraft lost due to a midair collision or to fratricide. That said, things weren't perfect and there were a number of things which could have been done better.

[10] Defense Science Board, Lessons Learned During Operations Desert Shield & Desert Storm, (DDRE, May 1992), p 20-1.

TACS/C2 Lesson Learned During Desert Storm

There were several key lessons learned during Desert Storm dealing with the TACS. Chief among these was the organizational problem caused by the unanticipated growth in the responsibilities of the Guidance, Apportionment, and Targeting (GAT) division of the operations directorate of the Tactical Air Control Center (TACC). Given the authority to develop daily attack plans and promulgate operational direction of the air campaign in December 1990, the GAT quickly took control of the entire ATO generation process. In doing this, it exercised responsibilities which had been formally assigned to other divisions under the operations directorate of the TACC. The GAT also took over much of the intelligence directorate's function and even conducted its own bomb damage assessment (BDA).

The GAT division was just one of the many important ad hoc command and control organizations. Another was the network of communications established among ABCCC and AWACS crews. TACPs accompanying U.S. ground forces, and "Fast FAC" forward air controllers as they worked to send coalition strike aircraft against the Iraq army deployed and dug in opposite coalition forces in Saudi Arabia. The ad hoc organizations were supported by great numbers of easy-to-use secure communications devices, particularly STU-IIIs. The volume of this communication nearly overwhelmed the communications equipment and personnel assigned to the theater.[11]

The rapid pace of the air campaign, coupled with the ability of new sensors such as JSTARS to monitor enemy movements in real time, outran the procedures by which the theater-wide ATO was constructed and disseminated. As General Glosson recognized, the ATO process was archaic.[12] It

[11] Ibid., p 24.
[12] Gulf War Air Power Survey, Vol. 1, Planning and Command and Control, p. 335.

depended on a lot of paper-and-pencil work and could not keep up with needs of units for planning materials such as accurate and timely BDA and estimates of enemy movement at night.

The existence of many ad hoc command and control organizations increased the impact of individual personalities. Because information such as BDA was often lacking, individuals who could get it faster gained influence over the direction of the air campaign during the planning of future missions. The ad hoc networks individuals created to gain information were usually based on informal contacts that grew out of past relations. For example, GAT personnel with Fighter Weapons School training reached out to former classmates and graduates. These contacts often took the place of standard operating procedures. Although these procedures often worked, at times they tended to circumvent the system and prevent proper information flow.

Much has been said about the JFACC's role during Desert Shield/Desert Storm. Lt. Gen. Horner had a difficult role to fill as the first official JFACC in a real world contingency. He had to deal with the JFC, the coalition air commanders, the other services, and the TACS, his primary tool for managing air operations. Lt. General Horner chose to focus his attention outside the TACS, leaving its day-to-day management to his deputies. He managed the TACS "by exception" intervening only when he believed it was necessary.[13] Although there was much bickering between services and to some extent between coalition air forces regarding the JFACC and the role he played, all services have now come to agreement that a JFACC is generally needed and should be appointed by the JFC during a campaign such as this. The issue of Marine Air and whether it should be under the control of the JFACC or the MAGTF/MEF Commander has also been resolved and is now incorporated into Joint Doctrine in the form of what used to be known as the "Omnibus Agreement". Probably the biggest issue which still needs to be resolved regarding the JFACC is not whether to

[13] Ibid., 336.

have one, but how the JFACC organizes and uses his planning team/cell to generate the ATO. This, in my mind, was the largest cause of bickering amongst the individual air forces within the coalition.[14] Because the GAT was very much an Air Force planning team with some services/forces not represented, there was little chance for these services/forces to influence the targeting and planning process of the ATO (except at the Joint Target Coordination Board). Each service should ensure representation within the targeting and ATO cells. The JFACC/JFC should require representation from each of the services since it ensures that service capabilities are not overlooked. Also, each service has different perspectives which should be considered.

Centralized direction of a theater-wide air plan is possible as Desert Storm demonstrated. However, the lack of common procedures, training, equipment, and software among the services as well as among coalition forces was a major obstacle to effective centralized command and control. The lack of compatibility of communications and tasking systems noted between the Air Force and the Navy highlighted a significant problem in C2 which can only be resolved through continued joint training and exercises, as well as through joint interoperability requirements and testing of equipment.

Few assertions about the Gulf War could command as much agreement as the inadequacy of BDA. What caused that inadequacy is not unanimous but there are several proposed reasons. Some say it was the desire for "perfect intelligence" to drive the decision making process. General Schwarzkopf told Congress that, "BDA…was one of the major areas of confusion…It led to some disagreements. As a matter of fact, it led to some distancing on the part of some agencies from the

[14] Smith, James K., Major USAF; I am an Air Battle Manager with 16 years of experience within the TACS with tours in a FACP, CRE, AWACS and an AOC. I've experienced two 60-day tours in Saudi Arabia and one 90-day tour in Kuwait in support of Operation Southern Watch and two 60-day tours in Turkey in support of Operation Northern Watch. I also spent a 60-day tour in Hungary in support of Allied Force. As a captain I attended the Marine Command and Control Systems Course and wrote a final paper on the JFACC and his role in Desert Storm. This conclusion is based on interviews with a number of Marine and Air Force officers with experience in the AOC during Desert Shield/Desert Storm.

position of CENTCOM at the time, as to what the bomb damage assessment really was."[15] Reasons for this…the intelligence staffs were not prepared for the enormity of the task, either in numbers of qualified personnel or in established and rehearsed procedures. Although operation plans and regulations detailed organizational structures to handle tasking of national reconnaissance assets, the system failed because of inadequate numbers of trained personnel in the process. Heavy overcast during the early days of the war prevented adequate assessment of many strategic targets, putting intelligence assessments behind from the outset of the campaign. A lag existed between imagery collection of a target and the time taken to disseminate it to planners for consideration in the ATO cycle. Also, imagery interpretation proved to be a difficult art. It was difficult to assess damage to Iraqi hardened aircraft shelters and command bunkers attacked by penetrating bombs. Unfortunately, the requisite expertise on structural vulnerabilities and weapons effects resided in Washington and the ATO planners were in Riyadh. This meant that some hardened shelters ended up being attacked again and again. Although most would acknowledge that expectations for intelligence may have been unrealistically high, the BDA system failed to meet the requirements. It is an area, therefore, which has gained a great deal of attention, not only in the intelligence community, but also in the military and DoD community focused on the modernization effort.[16] The Air Force is addressing each of these issues as it looks to the future.

Impact on the TACS

Since Desert Shield/Desert Storm most of these issues have been worked hard with significant headway being achieved. In the area of organization, joint doctrine has taken the lead in establishing guidelines while still allowing for the flexibility of the JFC to organize as he deems necessary given

[15] Rpt, Investigation Subcommittee on Armed Services, *Intelligence Successes and Failures in Operation Desert Shield/Desert Storm,* House of Representatives, 102d Congress, 2d session.
[16] (S) DIA, *Final BDA Status Report,* GWAPS CHST 49-1; (S) Bomb Damage to Iraqi Military Forces, GWAPS NA 109.

his personality and the situation. This said, all the services now seem to have accepted the value of a JFACC in a major contingency where all services bring an air arm to the fight.

During Desert Shield/Desert Storm Lt. Gen. Horner clearly had an Air Force dominated planning staff and was following an Air Force playbook when it cam to generating the ATO. Since Desert Storm a joint training center has stood-up with the mission of standardizing the ATO process as well as training personnel assigned to an AOC or service equivalent. This joint training center also sends instructors around the world to educate service personnel on the ATO process. This training, given its joint focus, should help to standardize the ATO process and thereby reduce much of the ad-hoc nature witnessed during Desert Shield/Desert Storm.

Compatibility of communications continues to be a huge issue not only in the TACS but within each of the services as a whole. A joint organization exists with the sole mission of ensuring the compatibility/interoperability of each and every new piece of communications equipment or system purchased by any of the services. Hours and hours of interoperability testing are required prior to the purchase of any piece of communications equipment. This testing, although it will probably never totally eliminate every interoperability glitch out there, given the multitude of possible network configurations, it will hopefully resolve major problems like the navy not being able to receive the ATO.

Unfortunately the BDA issue is an issue which is not going to be resolved within the TACS. Although not resolved, BDA has become a priority issue among the intelligence community. They have made changes in their organization and dissemination process which have demonstrated significant improvements. Timely BDA, however is very much a money issue. Technology exists which permits dissemination of timely BDA, however this technology (satellites, UAVs, and other airborne reconnaissance platforms) cost a great deal of money. In addition, you need very large

communication pipes capable of handling extremely large data rates to pass intelligence data. These networks don't exist in most areas of the world the military is engaged and therefore must be built from our own equipment. Although it's probably safe to say that the BDA issue will not be totally resolved anytime soon, given current budget constraints, the intelligence community is at least making strides in educating senior military leaders on what they can realistically expect in the way of BDA. By educating commanders and senior leaders throughout each of the services, there should at least be more realistic expectations in the future. The importance of BDA has also impacted the ATO process with planners now placing considerably more emphasis on BDA. That emphasis takes the form of added sorties generated to perform the BDA mission.

The 21st Century Air Force

As the Air Force enters the 21st century, it, like the other services, finds itself having to find ways of doing more with less. In comparison with its Cold War days, the Air Force is now one third the size with 66 percent fewer permanent bases. Yet, the current world environment and our national policy of engagement dictates that the Air Force deploy four times as often as just 10 years ago.[17] This increase in operations tempo has created the need for a search for a better way to go to war. This better way of going to war is the Expeditionary Aerospace Force (EAF). The EAF is the way the Air Force is providing a responsive, tailored, task organized force to warfighting commanders to meet the challenges of the global security environment across any spectrum of conflict. At the same time the Air Force is transitioning to a capabilities-based EAF, it is investing in the modernization of its C2 capabilities. In this way it plans to "organize, train, equip, and sustain itself by creating a mindset and cultural state that embraces the unique characteristics of aerospace power – range, speed, flexibility, precision."[18]

The Air Force is also pursuing an answer to how best to command and control its forces in this expeditionary environment. The global nature of our security environment dictates that we possess the ability to "see" the battlespace, no matter where it occurs, in real to near real-time. This creates the need for the most advanced C2 capability for warfighters at any level of conflict. Modernizing C2 is about leveraging modern technology, adapting process to this new technology, and training our people to use this new technology. C2 is about "the right information, at the right

[17] *EAF Concept Brief*, HQ USAF/XOP Briefing, September 1999, slide 8, downloaded from http.//www.issues.af.mil/notam984.html
[18] Air Force Instruction (AFI) 10-400, *Aerospace Expeditionary Force Planning*, 1 Oct 1999, 2.

time, disseminated and displayed in the right way, so commanders at all levels can do the right things, at the right time, in the right way."[19]

As the Air Force proceeds down the EAF and C2 modernization paths, it is imperative that it does so in a coordinated fashion. The inherent nature of the EAF, one of highly mobile operations, lends itself to a greater requirement for connectivity between command elements and execution elements. The only adequate answer for this challenge is a robust C2 capability. Said another way, the Air Force must realize that C2 will enable the EAF. We must also remember the important role the TACS plays within the Air Force's C2 system. Any modernization which takes place must be integrated into the TACS as well. Another issue for the TACS is how they fit into the EAF concept and what changes, if any are needed to do so.

The EAF

> EAF is a journey, and we have many more steps to take along this path as we transform the Air Force from a forward-based, Cold War force to an expeditionary force able to respond to crises around the globe.
>
> - F. Whitten Peters, Secretary of the Air Force[20]

The EAF vision is a concept for organizing, training, equipping, and sustaining the 21st century Air Force, to meet the challenges of the new global security environment across the spectrum of military operations.[21] This concept addresses two major challenges. First, it seeks to provide a theater CINC with responsive, trained and tailorable forces for the conduct of war and for contingency plans. Second, the EAF concept aims to furnish a more efficient use of the active duty

[19] *AC2ISRC Mission Brief,* HQ AC2ISRC Briefing, 4 May 1999, slide 12, downloaded from the AC2ISRC website.

[20] Peters, F. Whitten, "Commentary: EAF is a Journey, Not an End State," 5 Nov 1999, Internet 6 Nov 1999, available from http://www.af.mil. He also goes on to stress that the EAF is a completely different way of looking at how we do our business; a fundamental change in the way we operate.

force combined with integration of the total force. To meet these challenges, the Air Force has organized itself into 10 Aerospace Expeditionary Forces (AEFs) and 2 Aerospace Expeditionary Wings (AEWs). This provides national leadership the ability to leverage aerospace power's inherent versatility and responsiveness, and to match forces to the needs of any crisis or contingency.

The EAF is a mixing of fundamental capabilities, equipment, and people from a cross-section of total force aerospace capabilities. An AEF consists of operationally linked units, geographically separated which can be organized and tailored for any warfighting operation. The AEFs are built around a 15-month rotation cycle. A 15-month cycle allows the 10 AEFs, 2 rapid response AEWs, and 5 mobility lead units to respond to crisis around the world and still complete necessary training required to maintain effectiveness (Figure 6). AEFs in total do not necessarily deploy, rather

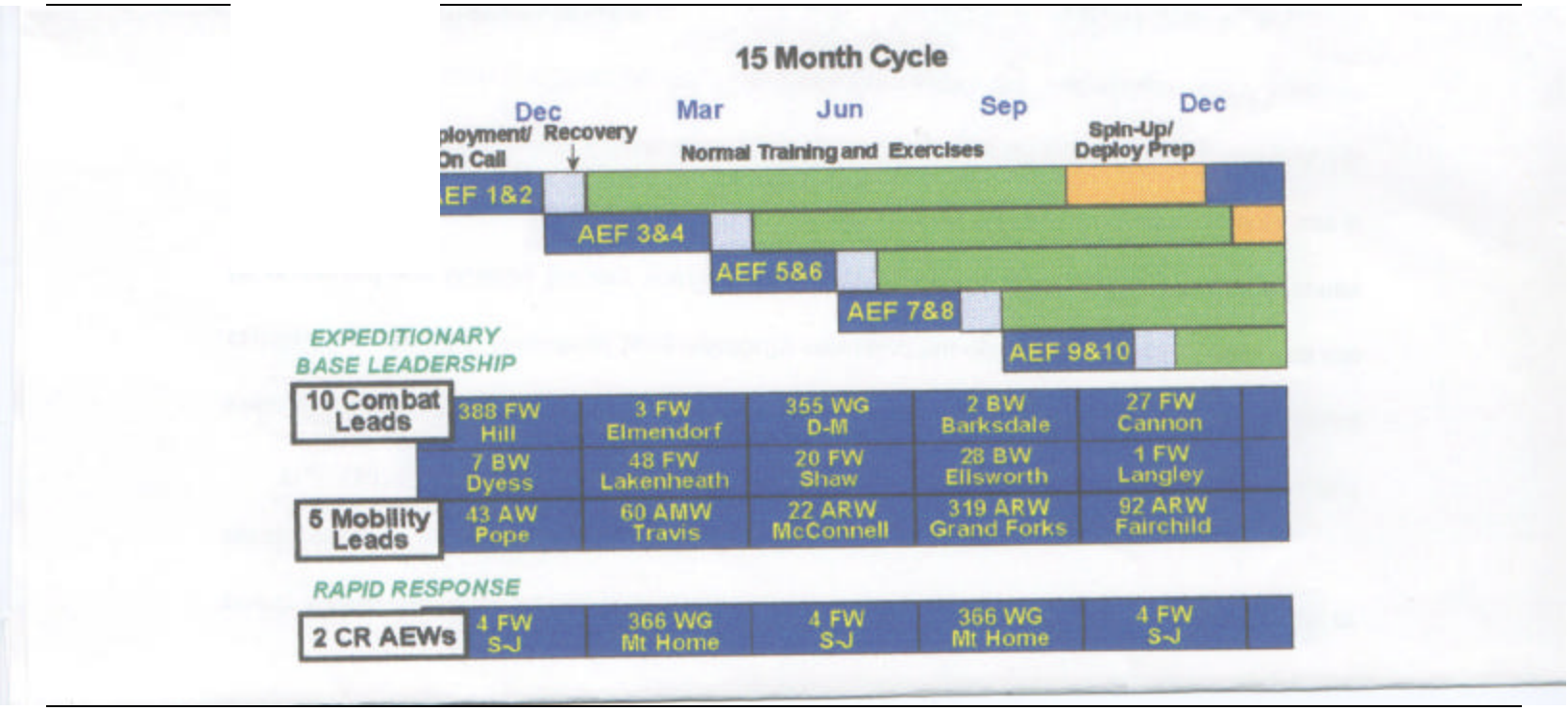


Figure 6.

[21] EAF *Concept Brief*, HQ USAF/XOP Briefing, September, 1999, slide 10, downloaded from http//www.issues.af.mil/notam984.html.

response Air Expeditionary Wings, Groups, Squadrons (AEWs, AEGs, AESs) will comprise the deploying forces depending on the needs of the CINC.

As seen in Figure 6, the deployment phase is one of four phases that an AEF goes through. The total rotation cycle consists of the deployment period, the recovery period, and the preparation for deployment phase. During the deployment phase (3 months), tasked units within the AEF deploy to fill any CINC requirements. Following their return from the deployment the units have a 1-2 week recovery period. Recovery is followed by a normal training and exercise period designated for normal requalification training along with participation in JCS exercises and ordinary leave for personnel. This period is followed by a month deployment preparation period in which designated units spin up for the designated area of responsibility (AOR) (if known). This brings us back to the beginning of the 15 month cycle and the 90 day deployment eligibility period.

Complementing the AEFs and AEWs are five Lead Mobility Wings (LMWs) and two Contingency Response (CR) AEWs. The LMWs are each responsible for a 90 day period and provide trained leadership and assessment teams for short notice taskings such as humanitarian deployments or disaster response, while coordinating with the assigned AEF units to accomplish required planning and preparation tasks.[22] If deploying into a theater without establishing facilities, the LMWs will be responsible for establishing and running the airfields the AEFs deploy to. Finally, the two CR AEWs will alternate every 90 days to meet any "pop up" contingency power projection requirement. The two CR AEWs contain an array of warfighting assets able to respond to conflicts worldwide. Any substantial or sustained commitment of forces beyond this level will constitute a surge for the Air Force,[23] which requires a reshuffle of assets to meet the warfighting requirements of

[22] Air Force Instruction (AFI) 10-400, *Aerospace Expeditionary Force Planning*, 1 Oct 1999, 11.
[23] Ibid., 2.

the CINC.[24] These specifically tailored forces will be presented to the JFC in the form of Aerospace Expeditionary Task Forces (ASETFs).[25] Regardless of the situation, whether in steady state or surge operations, the EAF is organized, trained, and equipped to respond to any global conflict.

Impact on the TACS

How does the TACS fit into this new EAF concept? The simple answer to that question is it doesn't, at least not very well. The majority of TACS assets are considered High Demand/Low Density (HD/LD) assets (with the few exceptions being the Forward Air Controllers (FACs) and Tactical Air Control Parties (TACPs)). As the label implies, there are not enough of these assets to go around. This means these assets have had to follow a slightly expedited rotation cycle making it impossible to match them up with the rest of the 10 AEFs. However, every effort has been made to flow these assets into a manageable cycle enabling them to achieve the same planned rhythm of deployment, downtime, training and exercises, and spin up for deployment, though at an expedited rate.

A second issue for the TACS in regard to becoming more expeditionary and thereby aligning itself better with the EAF concept, is the issue of deployability. Because of the reduction in airlift assets and the increased demand on our depleted airlift fleet, many of our heavy, airlift-taxing ground TACS units have become virtually non-deployable. The units which I am referring to are the CRCs, CREs, and even the AOC and ASOCs, (although to a lesser degree). The AOC has received a lot of attention in the last three years and great strides are being made to reduce the footprint of the AOC within the theater.[26] It is only recently that the Air Force has begun to look at reducing the size of the CRCs, CREs, and ASOCs. In addition to simply making equipment changes and replacing

[24] A more detailed explanation of the AEF structure can be found by further examining AFI 10-400 and the XOP brief. This rough outline of the AEF structure, however, provides the framework for the application of future C2 capabilities, which is provided later in the paper.
[25] AFDD 2 provides a detailed doctrinal guidance for presenting forces to the JFC.

heavy/bulky, outdated equipment with newer, lighter, more modern equipment (which takes time and costs money), there are more radical initiatives being recommended that will change the way these units do business. The CRCs and CREs are looking at the possibility of remoting the radar to a forward location, along with a small contingency of personnel needed for set-up, maintenance, and security and leaving the majority of the operators and operations vans/equipment in the rear area.[27] The ASOCs are also taking strides to reduce their size, although not to the extent the CRCs and CREs are considering (it's also not as big a problem). Most of their reductions will come in the way of small personnel cuts which can be realized through more capable and automated software programs. These programs can take the place of manpower. Together these initiatives should make these ground TACS units more deployable/expeditionary.

EAF is a new way of doing business for the Air Force. This new method demands a great deal from its C2 system. In many ways it will demand a great deal more than it has in the past. How does the Air Force plan on meeting those demands?

[26] By using the reachback capability addressed at greater length later in this paper, much of the planning can be done in the rear (RAOC), thereby reducing the size of the Forward AOC.

[27] A number of successful tests have been conducted in which the TPS-75 radar has been remoted hundreds of miles. Theoretically, it should be possible to remote the TPS-75 radar over satellite thousands of miles,

Command and Control Modernization

> Confronted with a task, and having less information available than is needed to perform that task, an organization may react in either of two ways. One is to increase its information processing capacity, the other to design the organization, and indeed the task itself, in such a way as to enable it to operate on the basis of less information. These approaches are exhaustive; no others are conceivable. A failure to adopt one or the other will automatically result in a drop in the level of performance.
>
> - Marvin Van Creveld, *Command in War*

In the last three years, the Air Force has taken great steps to modernize its C2. The first big step was the stand-up of the Aerospace Command and Control & Surveillance, Intelligence and Reconnaissance Center (AC2ISRC or the C2 Center) at Langley, AFB, VA.[28] The C2 Center is responsible for modernization planning, operational requirements, configuration control and Air Force experimentation, providing the vision for the future of C2 and joint C2 modernization. The modernization of C2 revolves around several key concepts: developing a global grid of information, standardizing AOCs, and training the people and processes within the C2 system.[29]

The concept behind the global grid is a "plug and play" C2 environment providing warfighters worldwide access to information. Put another way, the grid is an intranet for DoD use, based on C2 Link,[30] that establishes a protected and seamless information environment. Using C2

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although I am unaware of a successful test to accomplish this. The problem, which still needs to be overcome, is remoting the radios along with the control heads.

[28] The AC2ISRC headquarters is located at Langley, AFB, VA. Under its command are 14 field units scattered across the United States, the largest of which is the Command and Control Training and Innovation Group, located at Hurlburt Field, FL. In total, the Air Force has invested in over 1000 people who work C2 and ISR people and process issues on a daily basis.

[29] By no means are these three focus areas for modernization the only ones being pursued by the AC2ISRC. These areas best apply to the focus of this paper.

[30] AC2ISRC *Mission Brief*, HQ AC2ISRC Briefing, 4 May 1999, 32. The origin of C2 Link is Intel Link, a shared intelligence data environment developed by the Air Force intelligence community after Desert Storm. C2 Link provides warfighters with access to multiple C2 and Intel data sources using web browser and data mining technology.

hardware, software, and processes (tied together by the Integrated C2 System or IC2S),[31] the grid affords any commander, anywhere in the world the global connectivity and instant access to information needed to fight a war. This global network of information will be the backbone supporting aerospace operations and operation centers around the world. It will create an environment where place doesn't matter, i.e. commanders can be anywhere around the world and have access to the same information they had available in their stateside office or headquarters.

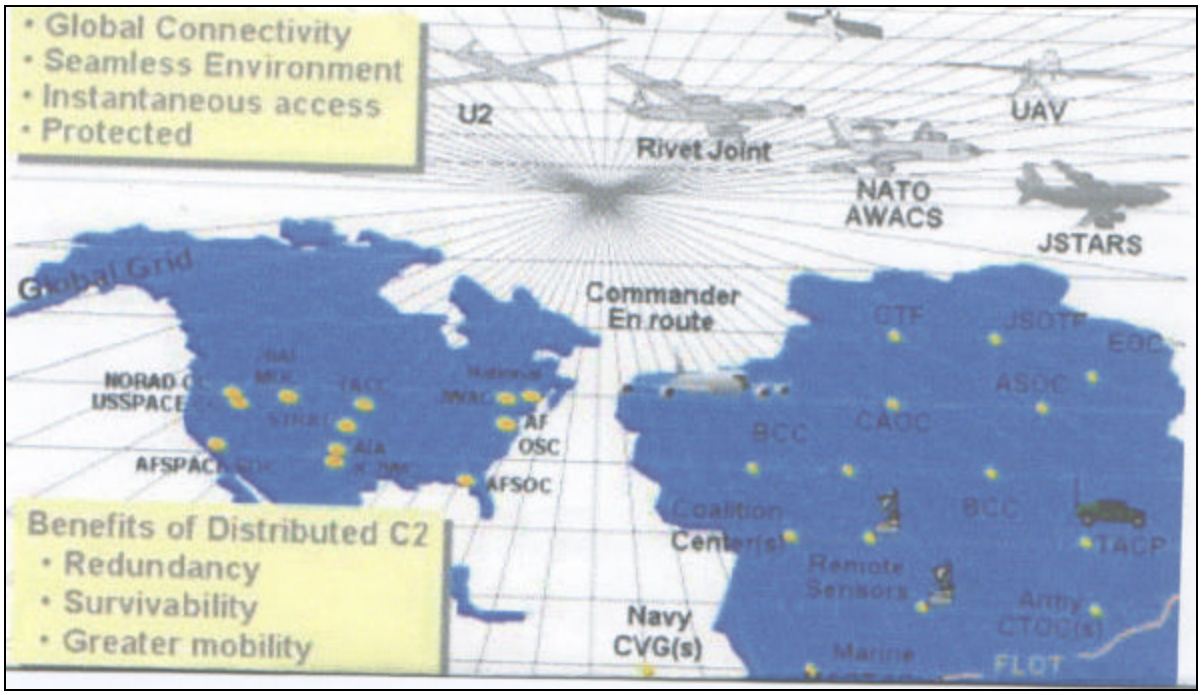

Figure 7.

After establishing the global grid, the next step is to enhance the nodes on the grid. The efforts for modernizing AOCs involve creating highly connected, standardized, and streamlined operations centers for commanding and controlling aerospace operations. Having command centers and processes configured in the same way at every level of C2 allows the flexibility required by a

[31] Ibid., 14. IC2S is a software suite that is overlaid on the global network allowing access by a variety of users. IC2S, supported by this network, provides the opportunity for worldwide collaboration and C2 flexibility.

light, lean, and lethal force in an expeditionary environment. From fixed stateside or theater level AOCs, to fixed or airborne operational level centers, to tactical level field C2 nodes, a standardized C2 capability will allow seamless aerospace operations. An integral part of the success of standardized AOCs is the people and C2 process used within the operations centers. Keeping this in mind, we can see that training will be the key.

Once the information environment and operation centers are developed, the next factor in delivering superior C2 for the EAF is C2 people and processes. The people who work in the command centers must be experts at C2 processes and equipment. To make this happen, the Air Force has begun training not only its senior leadership, at the JFC and JFACC levels, but also the men and women who work in the AOCs. This program called C2 Warrior, provides trained C2 professionals in every aspect of C2 warfare and C2 processes to the warfighting staffs.[32] C2 processes under development, that will benefit the EAF, revolve around concepts called reachback and collaborative virtual working environments.[33] The C2 warriors in command centers around the world will be the experts on the C2 processes and equipment that connect into the global grid and obtain information. These C2 warriors, trained on the latest C2 technology and processes used in standardized AOCs, will be able to plug into a global information environment for their warfighting needs. This will allow the EAF to realize its vision of creating the light, lean, and lethal force tailorable to any spectrum of conflict.

> We have put command and control into perspective; he who is able to control will Command not only his own forces, but those of an adversary.
>
> - General Michael E. Ryan, Chief of Staff, USAF

[32] *USAF Command and Control Concept of Operations,* Synergy, Inc. (Washington D.C., 1 Sept 1999), 1-4
[33] Both reachback and collaborative/virtual environments will be discussed later in the paper.

As technology continues to make remarkable advances, the modernization of C2 for the EAF must keep pace. C2 based on the technological backbone of a global network of information, operations centers, and sensors is currently obtaining the capability to rapidly fuse data into a cognitive battlespace picture for commanders. To continue this progress, however, it is imperative that every node on the global grid keeps pace with technological advances. To do this the Air Force is currently fielding the Integrated C2 System (IC2S) to standardize the most current capabilities for C2 across the Air Force.[34] To ensure that IC2S remains on the leading edge of technology, the Air Force uses the concept of spiral development for modernization of its C2 processes and systems.

Spiral development is a process that can rapidly take an idea from just a concept to an operational capability ready for fielding (Figure 8). It is a forum where developer, tester, and user can devise new ideas or refine old capabilities for warfighting needs. Unlike the traditional acquisition process, spiral development can take an idea and field it to the warfighter within 18 months (as opposed to at least 5 years).[35] Spiral development delivers the method for continually upgrading IC2S, providing the means for modernization of the IC2S Blocks.

To formalize the modernization of the IC2S, the Air Force has implemented a "Block" system much like that used for aircraft. The Air Force is fielding IC2S "Block 00" to stand up a global network that links data bases, operations centers, sensors and shooters. This C2 block design standardizes equipment in operations centers, databases, and message formats used throughout the

[34] *AC2ISRC Mission Brief,* HQ AC2ISRC Briefing, 4 May 1999, 42, downloaded from the AC2ISRC website.
[35] This is the nominal time period for implementing a piece of technology using the spiral process. With the rapid increases in the ability to produce new technologies, spiral development will enable the Air Force to keep pace with advances. This process is currently being used in conjunction with the JEFX cycle.

Air Force. Block 00 links AOCs, provides for information protection, employs collaborative tools, implements Theater Battle Management Core Systems (TBMCS), and is based on C2 Link.[36]

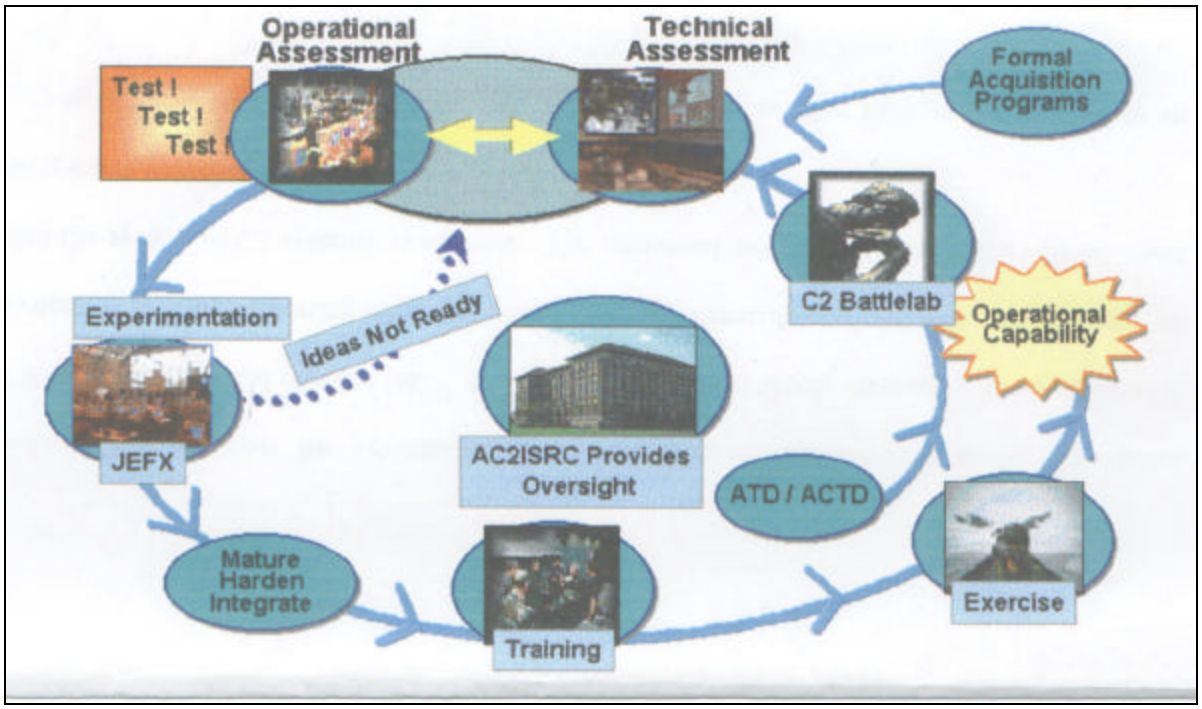

Figure 8.

It is critical to implement spiral development to enable the most rapid modernization of C2 processes and systems. The process begins with an idea, from advanced technology demonstrations, advanced concept technology demonstrations, USAF C2 Battlelab ideas, or within the formal acquisition process. From there, the developer, tester, and end user begin a process of assessments, both technical and operational. A series of tests validate the concept's technical ability and operational capability. Once an idea is ready for application, it is integrated into an experiment that links it with other systems and stress tests it in an operational environment. After a period of maturing, hardening, integration, and training, the developed concept is implemented into warfighting

[36]*AC2ISRC Mission Brief,* HQ AC2ISRC Briefing, 4 May 1999, 43, downloaded from the AC2ISRC website.

exercises and fielded to the warfighters. Spiral development is key to ensuring the most modernized IC2S is fielded to our warfighters.

An integral step in the spiral process is experimentation. The Air Force conducts the Joint Expeditionary Force Experiment (JEFX) on a biennial basis that takes the latest C2 and other warfighting technologies from the test phase to an operational environment for system validation and process development. JEFX creates a realistic warfighting setting by seamlessly combining live-fly and simulations. This environment enables new operational concepts and technologies to rapidly evolve and mature for delivery to the warfighter. With JEFX as its tool, spiral development provides the ability to rapidly advance both C2 systems and processes.

Impact on the TACS

The process of using spiral development to modernize C2 has only begun to realize its full potential for rapidly implementing C2 systems. Once again, up to this point, there has been little effort to incorporate a number of the ground TACS players into the JEFX and spiral development process. The entire focus has been on the AOC and the airborne members of the TACS, (AWACS, ABCCC, JSTARS, and Rivet Joint). If the Air Force is serious about training the way it fights, then it needs to begin to incorporate units like CRCs, CREs, ASOCs, and TACPs into its testing, experimentation, and training. [37] By incorporating the other elements of the TACS, not only will it make the testing and experimentation more realistic, it will also expose these units to some of the new systems and capabilities in development and enhance training. In addition, exposure to the spiral development process and the many contractors associated with the experiments would have the added benefit of addressing some of the shortfalls in equipment within these units.

[37] AC2ISRC Journal, Issue No. 1999-1, Spring 1999, *Spiral Development and JEFX,* p 6.

C2 in the EAF

> C2 includes both the processes by which the commander decides what action is to be taken and the system which monitors the implementation of the decision.
>
> - AFDD 1

To be successful, expeditionary forces must not only possess the ability to command and control their own forces, but they must also be connected with the command structure above them. The construct of the EAF provides significant C2 challenges. At the operational level of conflict, C2 requires coordination with the Unified Commander as well as other U.S. agencies. At the tactical level, supporting the AEF/AEW/LMWs, C2 requires horizontal and vertical links throughout the chain of command.

Designed to facilitate EAF operations, the AEF Center (AEFC) is a cross-functional, centralized, management team subordinate to Air Combat Command (ACC). The AEFC is responsible for AEF force package preparation for contingency steady state rotations and on-call AEW operational requirements, and integrating trained aerospace forces to meet theater CINCs' requirements across the full spectrum of operations.[38] Although not in a warfighting chain of command, the AEFC is the lead unit that aids the aerospace force providers by performing such tasks as theater war planning, time phased force and deployment data (TPFDD) development, aerospace asset and unit scheduling, expeditionary combat support (ECS) requirements, and readiness monitoring.[39] Critical to the success of this level of the EAF is a fully integrated C2 capability.

Except for mission execution, the AEFC is an integral part of every aspect of the EAF, and requires C2 connectivity throughout the warfighting continuum. To coordinate with the USAF

[38] Air Force Instruction (AFI) 10-400, A*erospace Expeditionary Force Planning*, 1 Oct 1999, 13.
[39] Ibid., 14-16. A more detailed explanation of the roles and functions of the AEFC is located in AFI 10-400.

components following initial requirement development and assist in translation of CINC course of action into TPFDDs, the AEFC requires full purview into force status and joint standard operating procedures, requiring adequate interoperable C2.[40] Essential to the deployment of forces in support of operations is the connectivity between the AEFC and the theater command structure (AOCs or the JFC command center). This not only gives the force provider the ability to task organize the aerospace forces to meet CINC apportionment requirements, but also provides the force commanders in the field with information on the units deploying into theater. At the tactical level, the AEFC assists the AEF/AEWs during the spin-up phase of their rotation cycle, by providing theater information, intelligence, and current operations plans. This information, obtained through the global grid, can be organized and disseminated to units who are training through C2 networks, ensuring the right tools for training for maximum readiness. By leveraging the available technology and the available information that C2 networks provide, the AEFC can help ensure the best trained aerospace forces are available to the joint warfighting commander.

Other Expeditionary C2 Requirements

The EAF also possesses other assets requiring access to the global grid to accomplish expeditionary missions. Expeditionary Combat Support (ECS) elements, who are typically part of a lead wing, are required for the rapid creation and sustainment of aerospace forces who are in the on-call status.[41] However, ECS planning considerations are applicable to all phases of EAF operations (preparation, deployment, employment, sustainment, redeployment, and reconstitution), and require a robust C2 capability. Also in need of C2 connectivity are the Air Force's Low Density/High Demand

[40] Interoperable C2 throughout the joint environment is a significant challenge. Continual modernization of the Air Force C2 capabilities is in full compliance with joint standards and requirements.
[41] Air Force Instruction (AFI) 10-400, *Aerospace Expeditionary Force Planning*, 1 Oct 1999, 26.

assets (U2, E-8 JSTARS, E-3 AWACS, RC-135 RIVET JOINT, SOF, CSAR, GTACS, etc.).[42] Although playing a critical role in expeditionary operations, these assets will probably not deploy as part of an AEF/AEW but will be on a separate rotation cycle, (currently a 60 day cycle). To communicate with the AEF commander or the JFACC, these units will need the same connectivity to the grid as the other units described. These special case elements of the EAF play a significant part in all expeditionary operations, and require no less than a full suite of C2 capabilities. Ensuring the connectivity for all these EAF units will be the C2 tools each possess.

C2 Tools

Based on the above outlined requirements for C2 in the EAF, there must exist a C2 suite of equipment in each unit allowing connection into the global grid, and the command of the expeditionary forces. The backbone for the EAF C2 is Theater Battle Management Core Systems (TBMCS). Developed in compliance with joint common operational environment requirements, TBMCS is a common C2 system that connects the warfighters at all levels in the joint environment.[43] Functionalities designed into TBMCS include CINC, force, and tactical level C2 tools and applications.[44] TBMCS brings together all levels of warfare into a single tool and when connected to the global grid, allows distributed C2 operations. Enhancing distributed operations is a collaborative environment where real time collaboration on expeditionary operations can occur. Collaborative tools (CT) provide warfighters with a web based/browser based tool that allows C2 and intelligence, surveillance, and reconnaissance (ISR) collaboration in real time.[45] Viewing TBMCS as one of many

[42] Ibid., 2.
[43] *Joint Expeditionary Force Experiment ' 99,* HQ AC2ISRC Briefing, October 1999, 20.
[44] *AC2ISRC Mission Brief,* HQ AC2ISRC Briefing, 4 May 1999, 28. The Joint Aerospace Applications designed in TBMCS include: CINC level – global awareness, strategy determination, and for organization, tracking and directing tools; Force level – situation assessment, plans development, and force control tools; Tactical level – tools that match crews, missions, aircraft, weapons, and airspace requirements.
[45] Ibid., 31.

web pages in CT creates a virtual environment where distributed and collaborative operations provide expeditionary warfighters at every level real time information, in the form of a near real-time common operational picture, to achieve the desired warfighting effects. These tools, along with other new C2 processes derived from this technology, provide the command and control that fulfills the requirements of the EAF. Once again testing and experimentation of these C2 tools have been reserved for the AOCs, operation centers, and to some degree airborne platforms like AWACS, JSTARS, ABCCC, and Rivet Joint but has been conspicuously neglected among the other ground TACS units. Clearly these units will require full access to these new C2 tools in order to remain a viable link in the C2 environment. The sooner we can begin integrating TBMCS and the other collaborative tools into the other ground TACS units, the sooner we will have a capable TACS able to take advantage of the benefits the new tools provide. It doesn't make sense to introduce and train certain members of the TACS on these new systems without training all members of the TACS. The TACS is a system and as such cannot function properly without each of its members.

EAF and C2 in Action

> The Air Force is committed to providing the integrated global and theater air, space and surface picture of the battlespace to the 21st century joint force commander.
>
> - Global Engagement

Command and control people, processes, equipment, and infrastructure provide the ability to build a picture of the battlespace. Whether viewing a picture of the threat, friendly forces, space forces, or logistics movements, this global capability will create an environment where "place doesn't matter." From fixed stateside or theater level AOCs, to fixed or airborne operational level centers, to

tactical level field C2 nodes, a standardized C2 capability should allow congruent, expeditionary aerospace operations.

Operations Centers

Currently the Air Force has 14 different worldwide 24-hour operation centers that have been networked together.[46] This network of operations centers, although not currently operating in concert, possesses the collective capability to build, through distributed collaboration, a near real-time picture of any battle space around the world. It is this linkage of operations centers via the global grid that the AF expects to provide C2 support to the EAF at every level of operations.

Networked operations centers, underscored and connected by the Integrated C2 System and the global grid, can greatly enhance expeditionary warfighting. By combining the information of the standing operations centers with expeditionary operations centers (those assigned to AEF/AEWs both fixed and airborne), a constant operating picture should be provided to commanders. Limited only by the information input to the network, EAF readiness should be assessed by displaying the status of AEF/AEW/LMW at any time. Near real-time theater intelligence can be obtained for use not only for military operations in progress but also in preparing expeditionary units for deployment. From issuing warning orders or training ATOs to providing enroute visibility of deploying units or global reach missions, the network of operations centers enhance expediency and lethality in the expeditionary environment. The greatest benefit of networked operations centers can be realized by implementing a concept called reachback.

[46] *Joint Expeditionary Force Experiment ' 99,* HQ AC2ISRC Briefing, Octorber 1999, 17. The operations centers that are currently linked together: AFSPACE AOC, Vanderberg AFB; AFOSC, Langley AFB; TACC, Scott AFB; AFWA, Offutt AFB; AIA, Kelly AFB; JWAC, Dalgren, VA; 1st Air Force, Tydall AFB; NORAD/USSPACE, Cheyenne Mountain & Peterson AFB; DAOC, Hickam AFB; DAOC, Ramstein AB; JTF-SWA, PSAB; JTF-NW, Incirlik AB; CAOC, Vicenza; and HTACC, Osan AB.

Reachback

Inherent to the ability to conduct light, lean, and lethal expeditionary operations is the requirement for a reachback capability. Reachback is the process of accessing, from a forward location, warfighting information and assistance from operations centers and data bases located in rear operations locations. By doing this, some warfighting functions within a forward operations center can be performed in an operations center located safely away from a crisis location. Having a robust network of operations centers located in rear locations (like in the United States) provides the capability to assimilate and process information and assist warfighters, in forward locations, with daily operations.

Enabling reachback is a secure and assured connection to the global grid of information. In this virtual/collaborative environment, where "place doesn't matter," normal functions of operations centers, whether AOCs or EOCs, can be performed in rear locations. Reaching back through a global network for information results in putting fewer people in danger and having a smaller deployment footprint in forward locations (in an AOC, reduction by an order of magnitude, i.e. 200 people instead of 2000[47]). For EAF operations, this means rapid deployments by AEF/AEWs into austere locations can be fully supported, both enroute and once established, by information and warfighters located in rear areas. This creates the capability for the JFC or JFACC to remain in the rear area, and still prosecute the war, until a full C2 capability is established in the forward area.[48] This also allows the commander to deploy forward (remaining fully connected by flying on a JFACC Enroute equipped aircraft[49]) while the majority of his support staff remains in the rear to produce the ATO.[50]

[47] Ryan, Michael E., "Expeditionary Aerospace Force for America," 14 September 1998, Internet 6 Nov 1999, available from http://www.af.mil.
[48] Though the capability may exist, this is a very controversial topic among the various services. Most services believe that you can't command from the rear.
[49] *Joint Expeditionary Force Experiment '99*, HQ AC2ISRC Briefing, October 1999, 24.

Maintaining an expeditionary force capable of worldwide action, real time information is a requirement for commanders and warfighters throughout the spectrum of conflict, and can be obtained through reachback.

In addition to a number of advantages provided by reachback come potential disadvantages as well. Clearly, this capability makes it even more likely to have senior officials (military or civilian) second guessing commanders in the field.[51] As our reachback capability continues to improve, senior military and civilian officials will need to guard against this temptation.

Sensor-to-Decision Maker-to-Shooter

The same network environment that enables reachback provides the ability to obtain information (through various means like ISR platforms) and rapidly integrate it in the battlespace. The concept of Sensor-to-Decision Maker-to-Shooter (SDS)[52] takes the information available within the operating network and provides real time, or near real time, information to the warfighter. The Air Force currently has the capability, much like the Navy's Network Centric Warfare,[53] to integrate the common air picture (provided by the Global Command and Control System) and provide it in real time to airborne aircraft. The capability also exists to obtain images of threats and transmit them to attack aircraft (sensor-to-shooter). SDS fuses not only the air but to some degree the ground threat pictures (using JSTARS sensor data). It also enables the commander in an operations center (who is not facing threats while flying in a combat zone) to view the total battlespace in near real time. This

[50] Ibid., 29. Although this concept is currently not widely approved of in the Air Force, it has succeeded during EFX 98 and JEFX 99. As the EAF continues to respond to crisis around the world, this way of operating should become more reliable and accepted.

[51] Visions of Vietnam come back to haunt us when President Johnson along with members of his staff were picking targets and thereby micromanaging the war effort.

[52] The Air Force is struggling to find a name for this concept, whether it should be called Dynamic Battle Control or simply Command and Control. For the purposes of this paper, I will refer to this concept as SDS.

[53] "Network Centric Warfare," 4 Jan 2000, Internet 25 Jan 2000, available from http://www.navy.mil.

fused information of the battlespace would allow the JFACC to make time critical targeting decisions and exploit this situational awareness of developing threats with precision engagement.

Through the connectivity and the distributed/collaborative environment provided by command and control, SDS provides the capability to react to emerging targets throughout the battlespace. Images from ISR assets like AWACS, JSTARS, or Predator can feed real time information through data links to both command centers and shooters.[54] The concept of SDS creates the capability to prosecute an air war with minimal pre-mission planning for the combat aircraft. Rather, the aircraft would be tasked, while airborne, to destroy time critical or emerging targets (by receiving real time information in their cockpits – RTIC), with a high degree of confidence (by the commanding authority) in the target information they receive. In the expeditionary environment of the future, "we have to find a way to deal with emerging targets…"[55] The answer is a robust C2 network, that fuses together battlespace information, which allows SDS operations, and network capable aircraft to precisely eliminate real time threats in that battlespace.[56]

Command and control people, processes, equipment, and infrastructure provide the ability to build a picture of the battlespace (Figure 9). By connecting standing operations centers (with their capability to collect, exploit, and disseminate ISR information) to airborne command nodes and expeditionary C2 nodes in forward areas, a shared data environment is created which provides information to commanders at all levels. Having the C2 tools to connect to a global network, expeditionary operators, located in tailored and scaled operation centers, are able to reachback to standing centers to obtain real time battlespace information. In this manner, the JFACC can deploy forward with only a few critical staff members, and direct combat operations with the support of rear

[54] Shooters being the name given to combat aircraft with the ability to destroy targets.
[55] *Joint Expeditionary Force Experiment '99,* HQ AC2ISRC Briefing, October 1999, 20. A quote from Lt General Lanny Trapp, JFACC for JEFX 99.
56 This is a capability which has only been demonstrated during experimentation, JEFX 00/01.

Figure 9.

operations centers. This same network allows real time information from sensors to be viewed by commanders and pushed to the cockpit of shooters for the real time prosecution of emerging targets in the battlespace. This reachback capability to standing operations centers from airborne or fixed forward centers to retrieve real time battlespace information is key to worldwide expeditionary operations. These C2 processes and systems provide national authorities with a lethal warfighting capability.

SDS and the OODA Loop

John Boyd argues that strategic paralysis of an enemy occurs when you can operate inside of his observe-orient-decide-action (OODA) loop. This can be accomplished by either tightening friendly OODA loops and/or loosening an enemy's OODA loops.[57] OODA loop speed and accuracy are essential to establishing an advantage over one's enemy. Sensor-to-Decision Maker-to-Shooter (SDS) provides the best capability to effect the OODA loop of an enemy. A comparison of the OODA loop, SDS, and current functions and tools is shown in Figure 10.

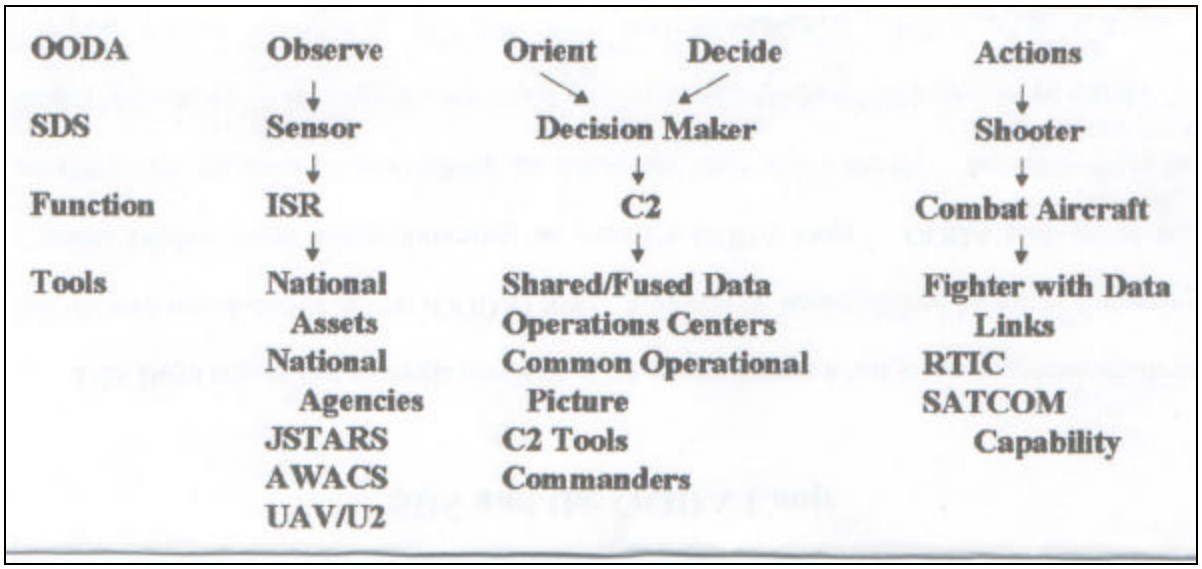

Figure 10.

No better way exists to achieve tightening one's OODA loop than through the combination of C2 and air power. In this environment, ISR data fused together, presented to commanders for decisions and linked to combat aircraft, or shooters. When SDS is compared to the OODA loop, ISR assets provide the **observation** of the battlespace. Command and control provide the **orientation** of the battlespace and decision capability for the commander (JFC, JFACC, ASETF commander, etc.).

[57] Faydok, David S., Major, USAF, *John Boyd and John Warden, Air Power's Quest for Strategic Paralysis* (Maxwell AFB, AL: Air University Press).

In a shared/fused data environment provided by a global C2 network, real time battlespace information is analyzed, **decisions** are made, and the right information is then data linked to the shooters. It is here that air power provides the "shooter," or the **action** that closes the OODA loop. From detecting an emerging target, to analysis between distributed operations centers, to target destruction by airborne aircraft (Figure 11), SDS provides the functions and tools to tighten our OODA loop to real time.

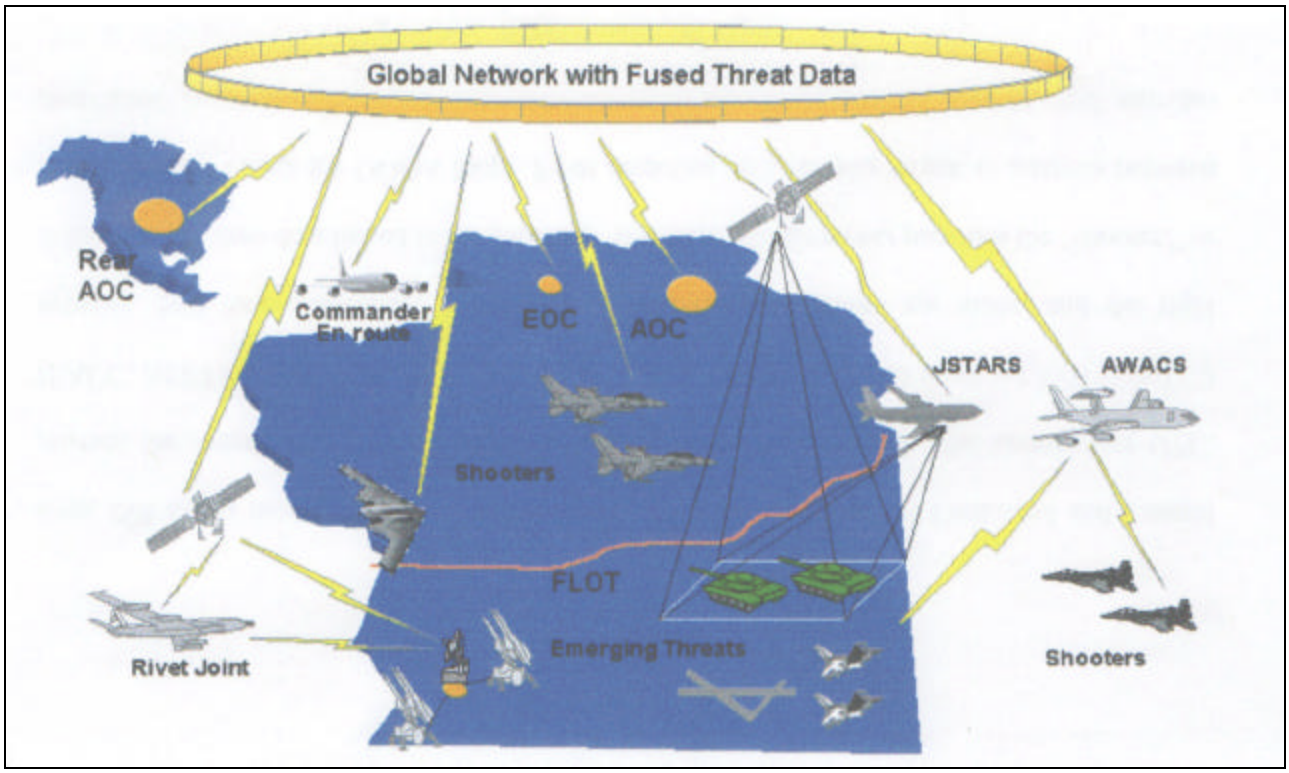

Figure 11.

Impact on the TACS

What is the impact of this network of operations centers, reachback and SDS on the TACS? The operations centers are the AOCs of the future. The advantage to having these operations centers linked via the global grid using reachback is manpower. The ability to see the same picture and have

access to the same information from any of these operations centers would have the effect of increasing a JFC's manpower and resources 10-fold. The TACS as we know it today will most likely cease to exist. Instead of a **Theater** Air Control System it will become a **World-wide** Air Control System (WACS). It is conceivable that as a crisis occurs in a given theater mobile units from what we now call the TACS would be deployed to the theater. These units would provide the theater sensors and links necessary to provide the operation center the battle picture. Assuming this operation center was linked into the global network it would then be feasible for controllers/air battle managers back in the states or any other globally connected operation center to control aircraft/shooters flying within the theater. This would create a truly World-wide Air Control System.

C2 Training

Although C2 processes and systems are key to an effective global command and control capability, it is the people, the operators, shooters, and commanders, who are essential to prosecuting a war by utilizing a global network of information. To ensure operators and commanders are able to maximize the potential of a shared/fused data environment for warfighting, the Air Force has created command and control warriors who are the keepers of the network and executors of the mission. Also, through robust communications networks, the Air Force is developing a Distributed Mission Training (DMT) environment providing its shooters with the capability to train with the latest C2 capabilities. Adequately training our expeditionary forces with the latest C2 process and systems will provide the most lethal aerospace warriors capable of worldwide expeditionary operations.

C2 Warrior

A C2 Warrior[58] is educated, trained, and certified in the aerospace operations, and is the primary operator in AOCs.[59] The Air Force views its operations centers at all levels as a weapon system, much like an F-16 or F-15. In this case, the operators of the AOC weapon systems are trained like pilots, receiving initial qualification and mission qualification training. This provides the C2 professionals who are experts at the systems and processes in an AOC. C2 Warriors are chosen from other disciplines across the Air Force (space, fighter and bomber operation, intelligence, mobility, logistics, communications, etc.). Bringing a certain expertise to the training, they are then trained on the systems and processes in the command and control environment. Once certified "mission ready" on the C2 systems supporting the AOC, they then work as operators in operations centers around the world.

Commanding these AOCs are senior leaders who are also provided training at the C2 Warrior School. This training, for the AOC directors (typically Colonels or Brigadier Generals) and JFACCs (Major or Lieutenant Generals) provides the senior leadership of the Air Force the knowledge of how to leverage the complex C2 systems and operations architectures located in today's AOCs. Armed with this training, a JFACC can arrive in an AOC anywhere in the world and quickly transition from peacetime to wartime operations. Possessing trained C2 Warriors at the operational and tactical level operations centers, the EAF can meet the demands of a full spectrum of global conflicts.

Training is the key to any weapon system. TACS units have been certifying their people as "mission ready" for years and ensuring they re-certify every 17 months. This is one area that other

[58] The C2 Warrior School is assigned to the C2 Training and Innovation Group, Hurlburt AFB, FL. The school trains C2 professionals at all levels.
[59] *C2 Warrior Vision*, Air Force C2 Training and Innovation Center Briefing, October 1999, 4.

members of the TACS community are far ahead of the AOCs. It is about time people in an AOC were trained and certified at the same level as the rest of the TACS.

Distributed Mission Training

Not only does the latest technology require that we train our operators of the AOC, it also provides us the opportunity to better train the operators of our airborne weapons systems. Linked through the robust network of the global grid, DMT links capable and realistic aircraft simulators at different bases.[60] This network of simulators, from fighter and bomber aircraft to C2 platforms like JSTARS or AWACS, enables operators to practice large force employment while geographically separated.[61] Also, by integrating a command structure (AEF/AEW/ASETF or JFACC) and leveraging the information available on the global grid, concepts like SDS and RTIC can be practiced on a daily basis. This not only benefits the operators at the tactical level, but also the commanders who make decisions regarding emerging targets in the battlespace. By integrating training at all levels, through the connectivity of DMT, the EAF will be fully prepared to conduct operations around the globe.[62]

Once again all members of the TACS have not been incorporated into this DMT network. Obviously, CRCs and CREs that perform many of the same functions performed by AWACS could benefit from such training. It would also be very beneficial to try and tie the Army into this network in order to practice the interface with the ASOCs, TACPs, and even air defense assets (Patriot and

[60] *USAF Command and Control Concept of Operations*, Synergy, Inc (Washington D.C., 1 Sep 1999), 2-4.
[61] DMT will be the key to AEF training in a geographically separated but operationally linked environment. While in the deployment preparation phase, simulated ATOs, large force deployments, SDS scenarios, etc., can be conducted by linking aircraft simulators, EOCs, and real time battlespace information to maximize AEF training and deployment preparation.
[62] This type of training is being conducted within the TACS on a quarterly basis as part of the System Training Program/Joint System Training Program. DMT will permit this type of training to occur on a weekly/daily basis.

Stinger). The Air Force and Army very rarely practice these procedures and thus typically are forced to relearn them during real-world contingencies.

The TACS on the Modern Battlefield

> What the Warrior Needs: a fused, realtime, true representation of the battlespace – an ability to order, respond and coordinate horizontally and vertically to the degree necessary to prosecute his mission in that battlespace.
>
> - Joint Pub 6-0

The success of the EAF concept is directly dependent on command and control. The basic nature of the EAF is a highly mobile force scattered across the globe for response to any crisis. Without instantaneous worldwide connectivity providing the battlespace picture to warfighters at all levels, the EAF will be unable to effectively prosecute real time expeditionary operations. A key to providing this connectivity is the global grid and the AOCs. The TACS provides the real time sensors feeding into the AOCs in the tactical environment via the various data links (TADIL-A, TADIL-B, JTIDS, ect.). The need for these sensors and data links doesn't go away with the advent of the global grid and thus the need for the TACS doesn't go away. However, the size of many of the ground-based units within the TACS (CRCs and CREs) that have to forward deploy could be significantly reduced. By reducing the forward footprint you would reduce the amount of airlift and support required in theater. The majority of personnel could then remain in an established facility able to plug into the global grid and conduct the mission. The same concept which has been tested with the AOC (whereby a small AOC is forward deployed with the theater JFC and JFACC and the larger Rear Area Operations Center (RAOC) provides support from the U.S.).

The deployment requirement for the airborne elements of the TACS, as they exist today (AWACS, JSTARS, ABCCC etc.) would not significantly change. However, it is a logical

conclusion that future weapon systems could be developed without the requirement for the large crews on board. What remains important is the sensors and the communications capability on board these systems not the crews performing the mission. It is conceivable for some of the operations crew to remain in the rear in relative safety and perform their mission in the future. This again could significantly reduce the footprint in theater not only reducing the threat to the crew, but also reducing the airlift and support requirements as well.

Recommendations and Conclusions

> The art of war deals with living and with moral forces. Consequently, it cannot attain the absolute, or certainty; it must always leave a margin for uncertainty.
>
> Carl von Clausewitz, *On War*

Despite the ever present and sometimes desperate words of Carl von Clausewitz, it is the commander's goal to command his forces to victory based on the best possible information available of the changing situation. In today's complex and high tempo environment where a commander must be prepared to act across the entire spectrum of conflict, it becomes even more critical to have a command and control system that is responsive to his needs. The Air Force is in the midst of a huge modernization effort aimed at that goal. Entering the new century the Air Force has organized itself into an expeditionary aerospace force capable of responding to any crisis around the globe. The only solution for guaranteeing the success of this new fighting force is a robust and responsive C2 system. The TACS will remain a viable part of that C2 system, however, it must continue to modernize and keep pace with the changing technology present in this continually evolving C2 environment. As of yet, the Air Force has not fully integrated the modernization efforts of EAF, C2 and the TACS. The Air Force must align its modernization efforts in order to assure its future success.

C2 modernization efforts like SDS, DMT and other C2 Tools must be integrated into all units of the TACS as opposed to just the AOC and select airborne members. By embracing spiral development as the means for modernizing our C2 force structure, the Air Force can ensure the most modernized, equipped forces are available to the CINC. The Air Force must begin incorporating all members of the TACS into their JEFX schedule in order to "work the bugs out" of all the TACS systems.

Senior Air Force leadership needs to embrace the concept of reachback and commit to conducting warfighting operations in a true distributed operations environment. By taking a "top down" approach to implementing reachback, the Air Force can more rapidly integrate this concept of warfighting. This can be accomplished by educating senior leaders on process and capabilities that C2 brings to the fight, and normalizing reachback in every day operations. This education will provide the confidence that JFCs and JFACCs need in order to embrace concepts like heavy rear/light forward operations, and ATO production in the rear instead of forward locations.

DMT must be adequately developed and funded to incorporate all TACS units. For the EAF to succeed with a force structure that is geographically separated but operationally linked, distributed training must occur. Here again, the TACS can play a vital role by providing additional sensors and data link feeds into the AOCs and operations centers around the globe. With the capability for integrating real time threat data, aircraft simulators, and command and control nodes, concepts like large force employment and SDS can be practiced on a daily basis by units of an AEF.

Increased C2 capabilities can create a situation where too much information is presented to commanders and warfighters. Critical to the success of C2 operations, the fusion of ISR information and C2 process must be carefully managed to prevent the situation where warfighters are overloaded with information (added emphasis to the idea of PIRs/CCIRs). Joint information management

standards for operation centers must be developed and implemented in order to effectively leverage all information available to our warfighters.

In a fused data environment where real time information of the battlespace is visible to commanders in AOCs, there exists an increased possibility for commanders, who are not flying the aircraft, to effect close control on the shooters operating in the battlespace. Commanders must use this increased visibility to enhance aerospace operations rather than inhibit them. The only way to ensure commanders do not overstep certain boundaries is through intense education on C2 capabilities and processes.

Desert Storm, with all its successes, recognized the need for a JFACC capable of commanding a multitude of aerospace forces. Fortunately, Iraq permitted allied forces to build up a capable C2 system which allowed Lt. Gen. Horner to exercise his C2 responsibility. In the next conflict we might not be so fortunate. The Air Force recognizes this and is therefore working hard to create a C2 system which meets the expeditionary requirement we're likely to face in the future. By creating the global grid, commanders will be able to "see the battlespace" no matter where it occurs, in real or near real time. The TACS is a critical part of that global grid, as such, it must remain capable of connecting to this C2 system thereby enabling the JFACC to command the aerospace forces of the future. Mobile members of the TACS must include the ground TACS members like the CRC, CRE, and ASOC. In order to be considered mobile these units must modernize in such a way that they can reduce their size and footprint. By reducing their size and footprint they would become more supportable by our limited airlift and therefore it would be much more feasible to deploy these units. Reducing the size and footprint would also reduce the manpower required to move and support these units. Given the global grid and reachback capability of these future systems, it would no

longer be necessary to deploy the large operations crews to man these systems since what is important is the sensors and the links to the network not the crew.

Command and control people, processes, equipment, and infrastructure provide the ability to build this picture of the battlespace. Having the C2 tools to connect to a global network, expeditionary operators, located in tailored operations centers, supported by sensors and data links from the TACS are able to reachback to standing operations centers and obtain real time battlespace information. This is the future of command and control and the future of the TACS.

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